THE GASTEROMYCETES OF AUSTRALASIA. XVI.

HYMENOGASTRACEAE, PART I: THE GENERA RHIZOPOGON, MELANOGASTER AND HYMENOGASTER.

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(Plate iv; twenty-seven Text-figures.)

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The family Hymenogastraceae, as defined herein, is held to contain commonly non-stipitate and tuberiform plants which are composed of a (usually) well-developed peridium enclosing a permanent gleba of tramal plates anastomosed to enclose numerous lacunae. Most of the species are hypogaean, and all are indehiscent; and because of this and their comparatively simple structure and development, members of the family are usually regarded as being the most primitive Gasteromycetes.

In most taxonomic treatments, genera are usually placed under two families: the Hymenogastraceae, in which the tramal plates are said to arise from the peridium; and the Hysterangiaceae, in which these structures are said to arise from a radial, basal sterile tissue. The developmental details given below show that this arrangement cannot be maintained; for it is now possible to arrange many genera in a developmental sequence which does not allow of this dissociation. It is likewise impracticable to maintain these families on morphological grounds, since there are no clear-cut features by which separation may be effected. Notwithstanding this, Dodge (1928, p. 468 *et seq.*) and Fischer (1933, pp. 7–32) have each arranged the genera under four families; the former recognizing the Rhizopogonaceae, Hydnangiaceae, Hymenogastraceae and Hysterangiaceae; the latter replacing the first by the Melanogastraceae, but considering the other three as valid.

General Morphology.

The indehiscent peridium is composed of hyphae either intertwined to form a felt-like tissue, or modified to form a pseudoparenchyma. In most species it consists of a single layer (the so-called simplex peridium of Zeller and Dodge, 1918); but in a few species it is formed of two or more distinct layers (the duplex peridium of Zeller and Dodge, 1918). In *Octaviania* and *Gautieria* occur a few species in which the peridium may be wanting at maturity, or reduced to a tenuous layer of loosely woven hyphae. In most genera the plants are attached to the substratum by one or several radicate strands, which may be produced into a rudimentary stem-like base (as in a few species of *Hysterangium*), or compacted to form a definite stem (as in certain collections of *Phallogaster*); but in *Rhizopogon*, *Melanogaster* and *Sclerogaster* the radicate strands are replaced by many or few strands which arise laterally and basally from the exterior of the peridium.

In all species included in the family the gleba is composed of numerous tramal plates anastomosed to enclose subglobose or labyrinthiform cavities. The plates are composed of intertwined hyphae or of pseudoparenchyma, may be fleshy or cartilaginous, and are lined with the hymenium, which in most genera is composed of basidia compacted into a close palisade. In *Melanogaster*, however, the hymenium is formed of a relatively broad zone of loosely intertwined hyphae among which the basidia are scattered. In the majority of species the gleba remains unaltered, but in a few (especially in *Hysterangium*) as maturity is approached there is a tendency for basidia and frequently the tramal plates (usually in large specimens) to become gelatinized, and in extreme cases to collapse and leave the central portions of the plant hollow. In the peculiar genus *Phallogaster*, partial gelatinization of areas of the gleba is followed by rupture of corresponding portions of the peridium; consequently in the mature plant the spores become exposed, embedded in a fetid gelatinous matrix. In several genera (as *Phallogaster*, *Dendrogaster*, *Gautieria* and *Hysterangium*) the gleba is partially or completely traversed by a simple or freely branched columella, usually arising from a sterile base. This structure may be conspicuous, scanty, or rudimentary in different species of the same genus, being often difficult to detect in herbarium specimens.

Basidia are usually cylindrical, less frequently subclavate, and bear from 1 to 8 spores on short or long sterigmata. The number of spores which the basidia bear cannot be used in generic delimitation, since in different species of *Hysterangium* (for example) the basidia may carry 2, 4, 6 or 8 spores. The spores may be globose or elliptical, hyaline or coloured, smooth or variously sculptured, and serve as admirable specific and generic characters.

Economic Significance.

At present little is known as to the economic role played by members of the family. Recent investigations have shown that a few species aid in the establishment of forest trees; for in New Zealand it has been demonstrated experimentally that *Rhizopogon rubescens* readily forms a mycorrhiza with *Pinus radiata*; and elsewhere *R. luteolus* has been found to perform a similar function. A few species have been reported as being edible, provided they are consumed before the gleba has become coloured. In this region many are sought for and devoured by marsupials and rodents, since partially eaten plants are often secured in the vicinity of scrapings made by these animals. Possibly the penetrating odour given off by several aid these animals in locating edible species.

Development.

As relatively few species have been studied ontogenetically, it is not possible to give a complete account of the developmental sequence of the family. Available particulars suggest the possibility of two or more phylogenetic series.

Rhizopogon is generally conceded to be the most primitive genus in the family, consequently details of the development of *R. rubescens* will serve as an introduction to the manner in which arise the essential structures as peridium and gleba. The development of this species was first studied by Rehsteiner (1892), and the following account is based partly on his work, partly on a recent study I have made from New Zealand collections.

The rudimentary plant arises from a small subclavate body upon the dorsal surface of a mycelial strand, usually in proximity to a maturing plant. Sections

show that it is composed of loosely interwoven hyphae of a type similar to that forming the mycelial strand from which it arises, there being no differentiation into cortical and medullary tissues, as with more complex species described below. As the plant enlarges, the interior hyphae become compacted, and in the central region appear a few large and irregular primary glebal cavities which are formed schizogenetically, and enclosed by somewhat compacted knots of hyphae which represent the primary tramal plates. As development proceeds, these plates become more compacted, increase in size, branch, and anastomose freely, so that the primary glebal cavities become divided into numerous smaller areas. Then further cavities and tramal plates arise peripherally to these first formed ones, and in this manner the interior tissues are shortly converted into the chambered gleba, the outer area being compacted ultimately to form the simple peridium. Additionally, further cavities form in the tramal plates, especially at the gussets and other regions where space permits. When plants are about 5 mm. diameter, the plates become lined with a definite palisade of closely compacted basidia, and then follows a period of intense spore production. Thus with this species glebal development commences in the centre of the plant and progresses centrifugally, and the peridium is formed from peripheral hyphae unused during development.

In *Octaviania tasmanica* development proceeds in the same general manner, for glebal cavities and tramal plates are formed first in the central portion of the plant, and subsequently are laid down centrifugally. But development differs from that of the preceding species in that the cavities and tramal plates are at first formed in small groups, separated by relatively wide regions of undifferentiated hyphal tissues (trabeculae), which foreshadow the dendroid columella of higher genera. Although these trabeculae are conspicuous in the developing plant, they become much thinner as glebal formation progresses, and in the mature plant are evident only as slightly thickened tramal plates. The peridium is formed in a manner similar to that described for *Rhizopogon*. The first formed basidia are not compacted into a palisade, but are somewhat irregularly inserted, suggesting affinities with *Scleroderma*, with which genus it agrees also in the manner of development. But as development progresses the basidia become more compacted and assume finally a palisade arrangement similar to that of other members of the genus. As particulars are not available as to the method of development of other species, it is not possible to indicate more fully the relationship of *Octaviania* to *Rhizopogon*.

Hysterangium sclerodermum is significant in that it tends to link the developmental characteristics of *Rhizopogon* (and possibly *Octaviania*) with those of the more complex species and genera possessing a well developed and permanent columella. As I have shown elsewhere (1924), differentiation of the primordium into cortical and clavate medullary regions commences at an early stage. Between these tissues appears a dome-shaped zone of cavities, and between each cavity passes a branch of the columella. As the plant enlarges, these branches elongate by peripheral growth, and produce numerous lateral branches, which become further branched to produce tramal plates. These in turn elongate, branch, and anastomose to enclose the cavities of the gleba. Additional cavities and plates are produced centrifugally, and where space permits, from earlier formed plates or even branches of the columella, so that as maturity is approached these become tenuous and much branched. The cortical tissue becomes compacted gradually to

form the pseudoparenchymatous peridium. When plants have attained a diameter of about 15 mm., tramal plates and branches of the columella become strongly gelatinized, after which increase in glebal tissue occurs apparently only in the peripheral region. Then follows considerable increase in diameter owing to the expansion of the gelatinized plates. In large plants most of the plates become tenuous and deliquesce, so that the interior becomes hollow save for a few persistent main branches of the columella, and the spores become embedded in a tenuous gelatinous matrix lining these and the inner surface of the peridium.

Gautieria novaezelandiae would appear to possess a similar development, for with this species, too, the tramal plates of the gleba are formed from the branches of the columella, and are also laid down centrifugally. In large specimens development continues until the branches of the columella are largely converted into sporogenous tissue, and in consequence are barely perceptible in mature plants.

Both *Hysterangium sclerodermum* and *Gautieria novaezelandiae* serve as intermediaries by which plants with a development similar to that of *Rhizopogon* may be linked with *Hysterangium lobatum* and *H. tunicatum*, and, as is shown below, these in turn are directly associated with the highest members of the series.

In *Hysterangium lobatum* the first cavities are laid down in a dome-shaped zone between cortical and medullary tissues, as in *H. sclerodermum* (the sterile lobes of the former developing at a considerably later period); but development proceeds in such a manner that small isolated blocks of glebal cavities and corresponding plates are formed, each block being separated from its fellow by one of the conspicuous branches of the columella. This results in the formation of isolated but completely differentiated areas of the gleba at quite an early period. Subsequently additional plates and cavities are formed at the peripheral margin of each, but the process is so gradual that these blocks retain their individuality until the plant approaches maturity. When glebal development is practically completed, there arise from the dorsal surface of the medullary or potentially sporogenous tissue, clavate or subglobose sterile lobes, which are often of a size as great as that of the sporogenous tissue. These structures are at first composed of woven hyphae, but ultimately become strongly gelatinized; although their function is unknown, their origin suggests that they are merely undifferentiated sporiferous tissue.

In *Hysterangium tunicatum* the usual dome-shaped zone of primary glebal cavities is formed beneath the cortical layer. These cavities arise from the periphery of the medulla and are separated from one another by the primary branches of the columella. The species differs from those discussed above in that further development is confined to centrifugal growth of the primary and subsequently formed branches of the columella (which arise through dichotomous branching of the first-formed branches). As these branches increase in length they carry outwards the tissues of the cortical layer, which ultimately become compacted to form the pseudoparenchymatous peridium. In consequence of this type of development, the cavities are radially arranged, and greatly elongated. According to Fitzpatrick (1913), a similar type of development occurs in *Hysterangium clathroides*, and the close relationship of these two species is further strengthened in that the spores of both are at maturity covered with a delicate gelatinous tunic, which, delicately wrinkled in *H. clathroides*, is considerably inflated in *H. tunicatum*.

From the details given by Fitzpatrick (1913), it would appear that *Phallogaster saccatus* and *Gautieria graveolens* show the final stage of this series; for in these plants the primary cavities appear immediately beneath the cortex, and further development would appear to be due entirely to peripheral development of tramal plates, the rudimentary columella remaining practically unaltered through the period of development.

Hymenogaster would appear to belong to a different developmental series, if particulars given by Rehsteiner (1892) of the development of *H. Rehsteineri* are typical of the genus. For in this species there arises in the apical portion of the central region a large irregular cavity, and into this, from the roof of this cavity, several tramal plates grow vertically downwards. These plates elongate, branch, and anastomose to form the chambered gleba, and finally fuse with the basal portion of the as yet undifferentiated gleba.

Taxonomy.

During the preparation of this and the following papers on the Hymenogastraceae, numerous difficulties have been encountered in the arrangement of species and genera. In several genera it was found that the characters upon which they were erected were untenable, with the result that emendation of a few and suppression of others became necessary. Additional difficulties have been introduced owing to the divergent views held by different workers as to the limits of the family. Thus certain workers consider that *Melanogaster* is a member of the Sclerodermaceae; *Phallogaster* a member of the Phallales; and others would place under the Hymenogastraceae unrelated genera, as *Secotium* and *Podaxon*. That there exists considerable difficulty in differentiating between genera of the Hymenogastraceae and the Phallales is evidenced by the fact that several instances are known where Phalloid "eggs" have been described as species of this family. Examples in point are *Rhizopogon Rodwayi* McAlp., *Hysterangium burburianum* Rodw., *Phallogaster globosus* Lloyd, *Protubera africana* Lloyd and *Kupsura sphaerocephala* Lloyd.

In the delimitation of species, similar difficulties have been encountered. Owing to the scanty descriptions given by many earlier workers and to the fact that in many cases no types are extant, it has been practically impossible to ascertain the identity of many of the older species. In many cases, species were described from single plants which, although in existence, are often too fragmentary to permit of their being identified with certainty. Many records are based on misdeterminations, and in such cases, unless the actual plants are available, it is seldom possible to ascertain to what species the collection should be referred.

As the object of any taxonomic revision is to present genera and species in such a manner that they may be recognized by subsequent workers, I have considered it advisable to indicate the characters, both generic and specific, which are least liable to be affected in consequence of the preparation of specimens for the herbarium. For the taxonomist is usually placed in the unfortunate position of being compelled to work with dried material. Thus the size, colour, and markings of the spores, the structure of the peridium and tramal plates, and the number of spores carried by the basidia, are specific characters which may be used with safety. Whereas the colour of the peridium (and often of the gleba), shape of the plant, and nature of its exterior, are of little, if any, practical specific value, since these factors are usually altered in drying. The thickness of the peridium and tramal plates has little comparable value, since this feature

depends upon the age of the plants at the time of collection, and upon the manner in which the specimens were preserved. The presence or absence of a sterile base is likewise of little value, since this feature varies in different plants of the same collection. As generic features, the position of the organs of attachment, whether lateral (as in *Rhizopogon* and *Melanogaster*), or basal, as in the majority of genera; the presence or absence of a columella (if clearly seen in dried plants); the shape and occasionally the colour of the spores may be considered of value. The presence of lactiferous ducts cannot be used with safety, since these structures may be seen in dried plants, as a rule, only when thin sections are treated with special reagents; and appear to be present or absent in different collections of plants agreeing in all other particulars. For this reason *Arcangeliella* is considered as a synonym of *Hydnangium*. It is likewise apparent that ontogenetic differences, not apparent in mature plants, cannot be used taxonomically.

Acknowledgements.

I am indebted to Dr. J. B. Cleland, The University, Adelaide, Mr. L. Rodway, Government Botanist, and Mrs. L. Rodway, Keeper of the Herbarium, Hobart, Tasmania, for the very generous manner in which they have made available their abundant collections for examination; and to Sir Arthur Hill, Director, and Miss E. M. Wakefield, Royal Herbarium, Kew, England; the late Abbé J. Bresadola, Italy; the late Dr. N. Patouillard, France; Prof. W. C. Coker, University of North Carolina, and Dr. S. M. Zeller, Corvallis, Oregon, United States of America; Mr. W. Carne, Department of Agriculture, Western Australia, and Mr. C. C. Brittlebank, late of the Department of Agriculture, Victoria, Australia, for donations or loan of specimens. Mr. H. Drake, of this Station, has kindly provided the photographs of specimens and line drawings reproduced.

Hymenogastraceae (including the Hysterangiaceae).

Plants hypogaean or epigaean, tuberiform, subglobose, or pyriform, without a distinct stem, but attached to the substratum by lateral or basal rhizomorphs. Peridium of one or two indehiscent layers. Gleba of permanent, anastomosed, fleshy or gelatinized tramal plates, enclosing cellular or labyrinthiform cavities lined with the hymenium. Basidia cylindrical or subclavate, bearing apically on short or long sterigmata from 1 to 8 spores. Spores globose or elliptical, coloured or hyaline, smooth or variously sculptured.

About 45 genera have been described in literature, but it is doubtful if more than about 18 are valid, of which the following 8 are known to occur with certainty in this region.

Artificial Key to the Genera.

Peridium with lateral and basal mycelial strands.
- Spores elliptical and smooth.
  - Spores hyaline or tinted only ..... 1. *Rhizopogon.*
  - Spores deeply coloured ..... 2. *Melanogaster.*
- Spores globose and verrucose ..... *(*Sclerogaster*).

Peridium with radicate mycelial strands.
- Spores globose.
  - Gleba traversed with an evident simple or dendroid columella .. 5. *Hydnangium.*
  - Gleba without a columella ..... 4. *Octaviania.*
- Spores elliptical.
  - Gleba without a columella ..... 3. *Hymenogaster.*

* A genus which may be present in this region.

Gleba traversed with an evident simple or dendroid columella
Spores smooth ..... 7. *Hysterangium.*
Spores verrucose or areolate ..... 6. *Dendrogaster.*
Spores longitudinally ribbed ..... 8. *Gautieria.*

Section I: Peridium with lateral rhizomorphs (mycelial strands), without a columella; spores elliptical and smooth.

1. Rhizopogon Fries and Nordholm.

Symb. Gast., i, 1817, p. 5; *emend.* Tul., *Giorn. Bot. Ital.*, ii, 1844, p. 56.—*Hysteromyces* Vitt., *Not. nat. civ. sulla Lombardia*, i, 1844, p. 340.

Plants subglobose or tuberiform, without a definite sterile base, epigaean or hypogaean. Peridium tough and membranous, of stupose, sometimes gelatinized hyphae arranged in one or two layers; exteriorly covered with many or few adherent anastomosing dark-coloured fibrils which are united below to form mycelial strands or rhizomorphs. Gleba of permanent tramal plates anastomosed to form subglobose or labyrinthiform cavities. Spores hyaline or tinted, smooth, elliptical or less commonly obovate. Basidia subclavate or cylindrical, usually soon collapsing, bearing 2–8 spores on short sterigmata.

Type species.—*Rhizopogon luteolus* Fr. et Nordh.

Distribution.—Practically world-wide.

Habitat.—Growing in or upon the ground, usually in sandy areas rich in humus.

The genus is characterized by the smooth, pallid, usually elliptical spores, and the mycelial strands which arise from different parts of the peridium. The latter may be copiously developed (*R. luteolus*) or scanty (*R. rubescens*), and may be simple, anastomosed to form a network upon the exterior of the peridium, or aggregated into conspicuous rhizomorphs. Its nearest relative apparently is *Melanogaster*, since both possess these lateral rhizomorphs, and in addition similar elliptical smooth spores, and comparable glebal tissues. Separation may be effected by the deeply coloured spores and different hymenium of *Melanogaster*.

About 30 species have been described, but it is doubtful if more than about half this number are valid. In this region, but three species are known to occur with certainty, two having a wide distribution, the third being endemic to Australia.

Key to the Species.

Peridium of two distinct layers, spores obovate ..... 1. *R. clelandi* G. H. Cunn.
Peridium of a single layer, spores elliptical.
Gleba strongly gelatinized and indurated ..... 3. *R. luteolus* Fr. et Nordh.
Gleba fleshy, firm though soft ..... 2. *R. rubescens* Tul.

1. Rhizopogon clelandi, n. sp. Text-figs. 3, 6.

Plants subglobose, to 3·5 cm. diameter, pallid-cream colour, drying lemon-yellow or tawny-brown. Peridium 400–800μ thick, of two layers; the outer of partly gelatinized hyphae, peeling away in shreds and exposing the inner layer, which likewise is of partly gelatinized hyphae but more firmly compacted. Fibrils few, adnate, absent above, rhizoid-like below, sometimes wanting. Gleba cream-coloured, becoming tawny, fleshy, not at all indurated; cells subglobose, empty; tramal plates 70–100μ thick, scissile, of woven hyphae, not at all gelatinized. Spores hyaline, obovate or less commonly subglobose, 7–8·5 × 4·5–6μ (rarely to 10μ long), shortly pedicellate, smooth. Basidia persistent, 2–4-spored.

Distribution.—Australia. South Australia: Second Valley, Forest Reserve, 6/30, J. B. Cleland* (3 collections, type locality).

* An asterisk denotes that the collection in question is in the herbarium of Dr. J. B. Cleland, The University, Adelaide.

The double-layered peridium, obovate spores and persistent basidia are the characters of the species. The double peridium associates this with four species described by Zeller and Dodge (1918) from the Western region of the United States; but the spores and basidia show it to be distinct from any of these. Basidia and spores are not typical of the genus, so that were it not for the lateral fibrils, the species would be better considered under *Hymenogaster*. Although the plant is apparently without smell when fresh (according to the collection notes of Dr. Cleland), herbarium specimens have a strongly aromatic odour as of aniseed.

2. Rhizopogon rubescens Tulasne. Pl. iv, figs. 1, 2; Text-figs. 2, 5.

Giorn. Bot. Ital., ii, 1844, p. 58.—*Hysterangium rubescens* Tul., *Ann. Sci. Nat.*, ser. 2, xix, 1843, p. 375.—*Melanogaster berkeleyianus* Br., *Ann. Mag. Nat. Hist.*, xv, 1845, p. 41.—*Rhizopogon lapponicus* Karst., *Finska Bidr. Nat. Folk.*, xlviii, 1889, p. 19.

Plants gregarious, sometimes caespitose, irregularly globose or tuberiform, to 6 cm. diameter, at first white, then lemon-yellow, drying bay-brown or ferruginous, often with a reddish tint, and tinged red where bruised or cut. Fibrils usually scanty above, more prominent below, though not infrequently almost wanting, appressed, dark brown or black. Peridium 150–300μ thick, of a single layer of loosely woven but firm hyphae, tawny or yellowish-brown in section, mixed with numerous amorphous globules of orange pigment. Gleba from tawny to ferruginous-brown, firm but soft and readily sectioned; cells subglobose, empty of spores; tramal plates 35–60μ thick, rarely more, slightly scissile, of loosely woven hyphae not at all gelatinized. Spores smooth, tinted, elongate-elliptical, ends rounded, 6–9 × 2·8–3·5μ. Basidia cylindrical, 6–8-spored.

Type locality.—Europe.

Distribution.—Europe; Asia; North and South America; Australia; Tasmania; New Zealand.

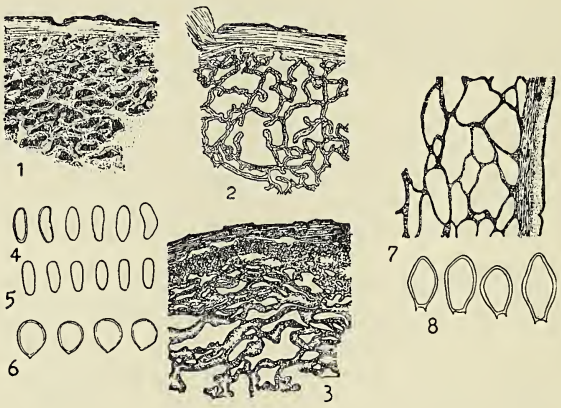
New South Wales: Milson Island, Hawkesbury River, 6/13, J.B.C.* (Det. by Dodge as *R. occidentalis*); Canobolas, 10/16, J.B.C.*; Blayney, 12/17, J.B.C.*; Mittagong, 7/19, J.B.C.*; Leura, 10/14, J.B.C.*.—Western Australia: Narrogin, W. Carne, 8/25; Perth, H. Elliott, 5/27; Mundaring Weir, 6/26, W. E. Campion (Collections ex Dept. Agric. W. Aust.).—Tasmania: Hobart, L. Rodway (ex herb. L. Rodway).—New Zealand: Auckland, Te Aroha, 6/23, G.H.C. (Det. by Dodge as *R. roseolus*); Hawkes Bay, Lake Tutira, 11/27, G.H.C.; Wellington, Tangimoana, 11/30, 10/31, 11/32, 2/33, E. E. Chamberlain; Canterbury, Ashburton, 8/25, D. W. McKenzie (Det. by Dodge as *R. roseolus*).

This species appears to be abundant in areas where *Pinus radiata* is growing, and forms a mycorrhiza with this plant, as has been demonstrated at this Station by Mr. T. C. Birch. As in Australia and New Zealand, it has been found only in proximity to pines, it is probably an introduced species, since the genus *Pinus* is not indigenous to this region.

The species is characterized by the fleshy nature of the gleba, which in herbarium specimens may be sectioned readily. The tramal plates are not gelatinized, a feature which separates the species from the following and explains why the plant does not become indurated when dried. I have compared our collections with specimens of *R. rubescens* from Europe (ex herb. Bresadola) and found them to agree in all essentials.

3. RHIZOPOGON LUTEOLUS Fries and Nordholm. Text-figs. 1, 4.

Symb. Gast., i, 1817, p. 5; *emend.* Tul., *Giorn. Bot. Ital.*, ii, 1844, p. 57.—*Rhizopogon induratus* Cke., *Grev.*, viii, 1879, p. 59.—*Melanogaster wilsonii* Lloyd, *Myc. Notes*, 1923, p. 1176.



Text-figs. 1-8.

1.—*Rhizopogon luteolus.* Drawing of section showing the indurated nature of the gleba. × 7. Original.

2.—*Rhizopogon rubescens.* Drawing of a section showing the nature of the tramal plates. × 7. Original.

3.—*Rhizopogon clelandi.* Sectional drawing showing the double peridium and scissile tramal plates. × 7. Original.

4.—Spores of *Rhizopogon luteolus.* × 570. Original.

5.—Spores of *Rhizopogon rubescens.* × 570. Original.

6.—Spores of *Rhizopogon clelandi.* × 570. Original.

7.—*Melanogaster ambiguus*, × 7. Section showing the compact peridium and tenuous tramal plates. (The cells are filled with spores, a feature not shown in the drawing.) Original.

8.—*Melanogaster ambiguus*, spores, × 570. Original.

Plants subglobose, oblong or tuberiform, to 3 cm. diameter, bay-brown or tawny-brown, often distinctly yellowish. Fibrils well developed, dark brown or black, appressed, rhizoid-like basally. Peridium 250–350μ thick, of strongly gelatinized woven hyphae, ochraceous or tawny in section. Gleba firm and indurated, at first white, becoming yellowish-brown, finally almost black in areas; cavities labyrinthiform, filled with spores; tramal plates 70–90μ thick, strongly scissile, of gelatinized hyphae. Spores tinted yellow, elliptical or occasionally irregular, 6–9 × 2·8–3·5μ, sometimes shortly pedicellate. Basidia subclavate, bearing 6–8 spores.

Type locality.—Europe.

Distribution.—Europe; Asia; Africa; North America; Australia; New Zealand.

New South Wales: Willoughby, 8/15, J.B.C.*.—South Australia: Mt. Lofty, 5/28, J.B.C.*; same locality, 4/24, J.B.C.* (Det. by Dodge as *R. roseolus*); Kuitpo, 5/21, 6/28, J.B.C.*; Kalangadoo, 5/28, J.B.C.*.—Tasmania: Hobart, L. Rodway (ex herb. L. Rodway).—New Zealand: Auckland, Rotorua, 2/27, G.H.C.; Blockhouse Bay, 3/32, M. Hodgkins; Canterbury, Banks Peninsula, Berggren, 1879 (Herb. Kew, No. 403, type of *R. induratus*).

Herbarium specimens may be recognized readily by their indurated nature, due to the tramal plates and peridium being strongly gelatinized, and the cavities of small diameter and filled with spores. Our collections agree well with European specimens (ex herb. Bresadola), and with the description given by Coker and Couch (1928, p. 33) of a plant so named by von Hoehnel from Europe; but differ considerably from the description given under this name by Zeller and Dodge (1918, p. 10). Through the courtesy of the Director of the Royal Botanic Gardens, Kew, and Miss E. Wakefield, I have been enabled to examine a slide prepared from the type of *R. induratus* Cke. and find this to be based on a specimen of *R. luteolus*. Examination of part of the type (kindly loaned by Dr. Shear) shows that *Melanogaster wilsonii* Lloyd (Lloyd herb. No. 53361) was also based on a specimen of this species.

Doubtful and Excluded Species.

(*a*). *Rhizopogon induratus* Cke = *R. luteolus* Fr. et Nordh.

(*b*). *R. occidentalis* Z. et D.—A collection from Milson Island, in the possession of Dr. Cleland, has been identified by Dr. Dodge as this species. I have examined these specimens and consider they belong to *R. rubescens*.

(*c*). *R. pachyphloeus* Z. et D.—According to Zeller and Dodge (1918, p. 10), a collection of this species is in the Lloyd herbarium (Sydney, R. T. Baker, No. 03957). I have not seen specimens from this region.

(*d*). *R. rodwayi* McAlp., *Agr. Gaz. N.S.W.*, vi, 1895, p. 755.—The original description and illustrations show that this species was erected upon the "egg" of some phalloid.

(*e*). *R. roseolus* (Cda.) Hollos.—In the text are listed three collections which have been identified by Dr. Dodge as belonging to this species. I have been unable to ascertain to what species this name refers, as the original description is too scanty to permit of accurate diagnosis; and the matter is further complicated: whereas Zeller and Dodge (1918) described and illustrated a plant which appears to be a form of *R. luteolus*, Coker and Couch (1928) consider under this name a plant which is close to, if not identical with, *R. rubescens*. Examination of the three collections referred to has shown that two belong to *R. rubescens*, and one to *R. luteolus*, which further illustrates the fact that *R. roseolus* has no character by which it may be recognized.

(*f*). *R. violaceus* Cke. et Mass. = *Hysterangium sclerodermum* (Cke.) G. H. Cunn.

2. Melanogaster Corda.

Sturm., *Deutsch. Crypt. Fl.*, iii, 1831, p. 1.—*Uperhiza* Bosc., *Mag. Ges. nat. Freunde Berlin*, v, 1811, p. 88.—*Bullardia* Jungh., *Linnaea*, v, 1830, p. 408.—*Argylium* Wallr., *Fl. Crypt. Germ.*, ii, 1833, p. 874.

Plants subglobose or irregularly tuberiform, with branched fibrils arising from the exterior of the peridium, more numerous basally, hypogaean. Peridium of a simple tough layer of woven gelatinized hyphae, continuous with the tramal plates. Gleba of tramal plates anastomosed to form numerous polygonal or subglobose cavities, which are usually larger towards the centre and are at maturity filled with spores; hymenium of clavate, 2–8-spored basidia (commonly 2–4), which are not arranged in a definite palisade, but irregularly distributed through a broad hyphal zone lining the cavities. Spores borne on short sterigmata, elliptical or lemon-shaped, deeply coloured, smooth, shortly pedicellate.

Type species.—Melanogaster variegatus (Vitt.) Tul.

Distribution.—Europe; North America; Africa; New Zealand.

The genus appears to be closely related to *Rhizopogon*, from which it is separated by the deeply coloured spores and different arrangement of the hymenium. The basidia are not crowded into a compact palisade, as is usual in members of the family, but are irregularly distributed through a relatively broad zone of loosely woven hyphae which lines the cavities. (This feature is not apparent in mature plants.) On this account the genus was considered by Fischer (1900, p. 334) to be a member of the Sclerodermaceae. In his recent treatment, however, Fischer (1933, p. 9) placed it under the family Melanogastraceae. As is shown by the synonymy, the genus possesses two prior names; but as it has been almost universally known as *Melanogaster*, and as this last name has been proposed by R. Maire (*Rec. Synop. V. Congrès internat. Bot.*, 1930, p. 120) as a *nomen conservandum*, I have thought it advisable to use it herein.

Although several species have been described, it is probable that there are not more than four or five, the many others listed being synonyms of these or of species of *Rhizopogon* or *Hymenogaster*. The genus does not appear to occur naturally in this region, for the six collections examined were taken from flower beds, to which they had been apparently introduced with exotic cultigens.

1. Melanogaster ambiguus (Vittadini) Tulasne. Text-figs. 7, 8.

Fungi Hypogaei, 1851, p. 94.—*Octaviania ambiguua* Vitt., *Mon. Tuberacearum*, 1831, p. 18.

Plants tuberiform, to 2·5 cm. diameter, wrinkled exteriorly, black or almost so. Peridium 400–500μ thick, simple, of woven gelatinized hyphae, white internally, coloured deeply peripherally; fibrils numerous, laterally arranged, simple or aggregated below into prominent rhizomorphs. Gleba black, mottled with isabelline or white tramal plates, which are from 50 to 200μ thick, composed of firmly woven gelatinized hyphae; cavities irregularly subglobose, varying in size from 1 to 4 mm., larger towards the centre, filled with spores. Spores citriform, 11–15 × 7–10μ, almost black, smooth, apex somewhat acuminate, base shortly pedicellate.

Type locality.—Europe.

Distribution.—Europe; North America; New Zealand.

New Zealand: Wellington, Botanic Gardens, 6/25, G.H.C. (2 collections); Canterbury, Oxford, 10/21, G. Archey (3 collections); Otago, Dunedin, 5/22, Miss H. K. Dalrymple.

The species is separated from others of the genus by the large, lemon-shaped, almost black spores.

Excluded Species.

Melanogaster wilsonii Lloyd, *Myc. Notes*, 1923, p. 1176 = *Rhizopogon luteolus.*

Section II: Peridium with a radicate base; without a columella; spores elliptical, smooth or variously sculptured.

3. Hymenogaster Vittadini.

Mon. Tuberacearum, 1831, p. 20.—*Hymenangium* Cda., *Icon. Fung.*, v, 1842, p. 28.—*Hysterogaster* Z. et D., ex Dodge, in *Comp. Morph. Fungi*, 1928, p. 488. *Nomen nudum.*

Plants subglobose, pyriform or occasionally tuberiform, attached to the substratum by a radicate base or strands, lateral rhizomorphs being absent. Peridium of one or two layers, composed of stupose or pseudoparenchymatous hyphae. Gleba of tramal plates anastomosed to enclose numerous subglobose

cavities lined with the palisade hymenium; columella absent. Spores elliptical, coloured, smooth or more often covered with a firm, wrinkled or otherwise roughened gelatinous membrane; basidia persistent, cylindrical, bearing 2–4 spores on short stout sterigmata.

Habitat.—Growing superficially or partially submerged in soils rich in vegetable debris.

Distribution.—Practically world-wide.

Type species.—None indicated, but possibly *H. citrinus* Vitt.

The genus is separated from the two preceding ones by the absence of lateral rhizomorphs, the plants being attached to the substratum by one or several radicate strands; from *Octaviania* by the elliptical spores; and from the remaining genera present in this region by the absence of a columella.

In the genus there are two groups of species, characterized by the spores. In the first group these are quite smooth (apparently the basis of *Hysterogaster* Z. et D.); and in the second the spores are covered with a gelatinous utricle which appears delicately wrinkled, areolated or reticulated. Owing to the usual confusion which exists in literature, it is not possible to indicate, even approximately, the number of species in the genus. In this region I have been enabled to recognize ten, all save one of which would appear to be endemic.

Key to the Species.

Spores perfectly smooth.
- Spores 7-10μ long ..... 1. *H. Maideni* Rodw.
- Spores 13-16μ long.
  - Peridium reddish-brown ..... 2. *H. tasmanicus* G. H. Cunn.
  - Peridium golden yellow ..... 3. *H. aureus* Rodw.
- Spores 18-22μ long ..... 4. *H. fusisporus* (M. et R.) G. H. Cunn.

Spores covered with a membrane which in mature plants is rugulose-areolate or verrucose.
- Peridium of two distinct layers ..... 5. *H. luteus* (Mass.) G. H. Cunn.
- Peridium of a single layer.
  - Spores 12-16μ long.
    - Spores elliptical; 4 on each basidium ..... 6. *H. nanus* Mass. et Rodw.
    - Spores fusiform; 2 on each basidium ..... 7. *H. albellus* Mass. et Rodw.
  - Spores 16-22μ long ..... 8. *H. zeylanicus* Petch.

Spores with a strongly reticulated membrane.
- Endospore markedly thickened ..... 9. *H. macrosporus* G. H. Cunn.
- Endospore thin ..... 10. *H. reticulatus* G. H. Cunn.

1. Hymenogaster Maideni Rodway. Text-figs. 11, 18.

Proc. Roy. Soc. Tas., 1921, p. 157.

Plants irregularly globose or oblong, to 4 cm. diameter, dull white, becoming dingy brown when dried. Peridium 50–200μ thick, of closely woven gelatinized hyphae, hyaline. Gleba pallid buff or pallid cinnamon-brown, cells empty, subglobose, 1-2 mm.; tramal plates 50–100μ thick, of densely woven gelatinized hyphae; basidia 4-spored. Spores broadly elliptical or slightly obovate, pallid ferruginous, 7–10 × 4·5–6μ, perfectly smooth, shortly pedicellate.

Type locality.—Near Hobart, Tasmania.

Distribution.—Australia; Tasmania.

South Australia: Encounter Bay, 5/26, J.B.C.*; Second Valley, Forest Reserve, 6/30, J.B.C.* (2 collections); Stirling, w., 7/27, J.B.C.*; Upper Tunkalilla Creek, 6/30, J.B.C.*

This is separated from other species with smooth spores by the thin white peridium, and small size of the spores. The collections listed agree well with

the description of *H. Maideni*, and are included therein, although I have not had an opportunity of examining the type.

2. HYMENOGASTER TASMANICUS, n. sp. Text-figs. 10, 19.

Plants firm, subglobose, to 2·5 cm. diameter, reddish-brown and delicately tomentose. Peridium 150–200μ thick, of densely woven gelatinized hyphae, the outer layer becoming arranged with the hyphae radially disposed, much inflated and firmly compacted. Gleba olivaceous, firm and indurated, cells lenticular or less frequently subglobose, about 1 mm. long; tramal plates 60–80μ thick, of loosely woven hyphae embedded in a gelatinous matrix, scissile, tending to break down in the centre; basidia 2-spored. Spores broadly fusiform, tinted yellowish-brown, 11–15 × 4·5–6μ (occasionally to 20μ long), perfectly smooth, shortly pedicellate.

Distribution.—Tasmania: National Park, 1/28, L. Rodway (type collection in herb. Cleland).

The prominent vesiculose hyphae of the exterior of the peridium, olivaceous and firm gleba, and smooth tinted spores are the characters of the species. It resembles *Hysterangium* in the colour and firm context of the gleba; but as the basidia are typically those of *Hymenogaster*, and as no columella is present, it is evident the species belongs to this genus.

3. HYMENOGASTER AUREUS Rodway. Text-fig. 23.

Proc. Roy. Soc. Tas., 1923 (1924), p. 152.

Plants subglobose, 1–2 cm. diameter, exteriorly bright golden-yellow, drying yellow or some shade of yellowish-brown. Peridium 200–600μ thick, of a single layer of parallel interwoven hyphae. Gleba ferruginous, cells somewhat compressed, or lenticular, 3–4 mm.; tramal plates 24–40μ thick, of woven hyaline hyphae, somewhat scissile at the gussets; basidia chiefly 2-spored. Spores tinted yellow, smooth, fusiform, some allantoid or irregular, 12–16 × 5–7μ, apex acuminate, base pedicellate.

Distribution.—Tasmania: Wellington Falls, 2/02, L. Rodway (type collection); Mt. Nelson, 7/19, L. Rodway (Det. by Rodway as *Hysterangium membranaceum*).

This is separated from the preceding species by the differently coloured peridium and gleba, and different context of the tramal plates; and from *H. fusisporus* principally by the smaller spores.

4. HYMENOGASTER FUSISPORUS (Massee and Rodway), n. comb. Text-figs. 9, 20.

Hysterangium fusisporum Mass. et Rodw., *Kew Bull.*, 1898, p. 127.—*Hymenogaster barnardi* Rodw., *Proc. Roy. Soc. Tas.*, 1918 (1920), p. 157.—*Hysterogaster fusisporum* (M. et R.) Z. et D., Dodge in *Comp. Morph. Fungi*, 1928, p. 488.

Plants irregularly globose, 1–2 cm. diameter, smooth, yellowish, becoming brown when dried. Peridium 200–350μ thick, white in section, of closely woven, gelatinized hyphae. Gleba at first white, drying ferruginous or yellowish-brown, of minute cells, 3–4 mm., empty; tramal plates 20–35μ thick, of densely woven gelatinized hyphae, not scissile, brittle when old; basidia 2-spored. Spores elongate-fusiform, 14–22 × 6–8μ, pallid yellowish-brown, perfectly smooth, apex sharply acuminate, base shortly pedicellate.

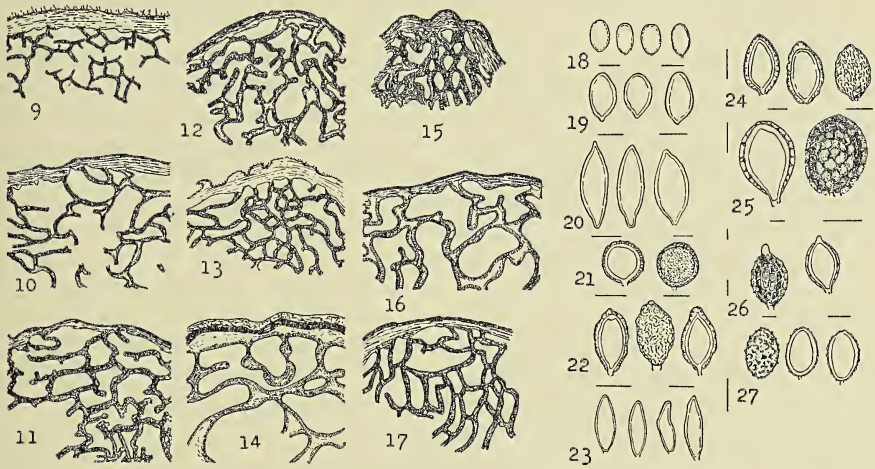
Distribution.—Tasmania: Unknown locality, L. Rodway (type collection, in herb. Rodway).

This is separated from the preceding species by the larger spores, which not infrequently attain a length of 22μ. The description has been drawn from part of the type collection, kindly loaned by Mrs. Rodway; and from this it will be seen that the plant cannot be considered under *Hysterangium*.

5. Hymenogaster luteus (Massee), n. comb. Text-figs. 14, 21.

Protoglossum luteum Mass., *Grev.*, xix, 1891, p. 97.—*Hysterangium viscidum* Mass. et Rodw., *Kew Bull.*, 1898, p. 127.

Plants irregularly globose, subglobose or pyriform, to 3 cm. in diameter, yellowish-ochre to ochraceous-tawny when fresh, and viscid, drying bay-brown. Peridium 250–400μ thick, of two definite layers, an inner coloured one of pseudoparenchyma, and an outer layer arising from this, of loose hyphae arranged radially and embedded in a thick gelatinous matrix. Gleba dark umber brown, firm, cells subglobose, about 1 or 2 mm. in diameter, empty; tramal plates 50–150μ thick, of woven strongly gelatinized hyphae, scissile, tinted; frequently with a rudimentary sterile base; basidia 2–4-spored. Spores broadly elliptical or slightly obovate, occasionally subglobose, golden-brown, 11–15 × 9–11μ, shortly pedicellate, covered with a gelatinous membrane which is 2·5μ thick and markedly areolate.



Text-figs. 9-17.—Sections of 9, *Hymenogaster fusisporus*; 10, *Hymenogaster tasmanicus*; 11, *Hymenogaster Maideni*; 12, *Hymenogaster zeylanicus*; 13, *Hymenogaster albellus*; 14, *Hymenogaster luteus*; 15, *Hymenogaster reticulatus*; 16, *Hymenogaster macrosporus*; 17, *Hymenogaster nanus*. All × 7. Original.

Text-figs. 18-27.—Spores of 18, *Hymenogaster Maideni*; 19, *Hymenogaster tasmanicus*; 20, *Hymenogaster fusisporus*; 21, *Hymenogaster luteus*; 22, *Hymenogaster albellus*; 23, *Hymenogaster aureus*; 24, *Hymenogaster zeylanicus*; 25, *Hymenogaster macrosporus*; 26, *Hymenogaster reticulatus*; 27, *Hymenogaster nanus*. All × 570. Original.

Type locality.—Victoria, Australia.

Distribution.—Australia; Tasmania, New Zealand.

New South Wales: Unknown locality, J.B.C.* (Det. by Rodway as *H. viscidum*).—South Australia: Mt. Lofty, 6/21, J.B.C.* (Det. by Rodway as *H. viscidum*); National Park, 7/25, J.B.C.* (Det. by Dodge as *H. nanus*); Stirling, W., 7/27, J.B.C.*—Victoria: Clarendon (Herb. Kew, No. 859, type of *Protoglossum luteum* Mass).—Tasmania: Unknown locality, L. Rodway (Herb. L. Rodway).—New Zealand: Wellington, Rimutaka Mts., 1/23, J. S. Yeates.

The viscid exterior (of fresh plants) and peculiar nature of the double peridium separates this from other species of the genus present in this region. The spores (save in shape) show relationships with several other species

described below, and show, too, that the plant cannot be considered under *Hysterangium*. When fresh the peridium may be as much as 2 mm. in thickness, due to the swelling of the gelatinous exterior, but in dried plants it is but 0·25 to 0·5 mm.

An examination of slides prepared from the type of *Protoglossum luteum* (kindly forwarded by Miss Wakefield, Royal Herbarium, Kew), has shown that this species possesses the spores and peridium of plants identified by L. Rodway as *Hysterangium viscidum*. In the original diagnosis of *P. luteum* it was stated that a well developed columella was present; but Miss Wakefield found that such was not the case, there being no trace of a columella in the type specimen. It is evident, therefore, that *Protoglossum luteum* is a *Hymenogaster*, and co-specific with *Hysterangium viscidum*; and as the former name has priority the species should be known as *Hymenogaster luteus*.

6. Hymenogaster nanus Massee and Rodway. Text-figs. 17, 27.

Kew Bull., 1899, p. 180.

Plants subglobose, to 15 mm. diameter, pallid-brown when dry, smooth. Peridium 100–200μ thick, of loosely arranged pseudoparenchyma, hyaline. Gleba with a well developed sterile base, ferruginous, cells 1–2 mm., subglobose, empty; tramal plates 35–60μ thick, of partly gelatinized pseudoparenchyma, hyaline, occasionally scissile at the gussets; basidia 4-spored. Spores broadly elliptical, ferruginous, 11–16 × 7–10μ, shortly pedicellate, covered with a gelatinous membrane which is arranged in the form of coarse irregular warts.

Type locality.—Hobart, Tasmania.

Distribution.—Tasmania: Hobart, Newtown Track, 6/25, L. Rodway (Herb. L. Rodway).

Although I have not seen the type, the collection from which the description has been drawn, identified by L. Rodway as being *H. nanus*, agrees well with the original diagnosis; and differs from the preceding (which Dodge identified as *H. nanus*) in the smaller cells of the gleba, different spores, and especially in the different peridium. The spores most closely resemble those of *H. albellus*, but differ in being elliptical and verrucose, not fusiform and areolate. The basidia, too, differ, being 2-spored in *H. albellus*, whereas in *H. nanus* they are 4-spored. Even when the spores are displaced from the basidia they retain their tetrasporous arrangement, being compacted into groups through adhesion of their gelatinized walls.

7. Hymenogaster albellus Massee and Rodway. Text-figs. 13, 22.

Kew Bull., 1898, p. 126.

Plants subglobose to shortly pyriform, 1–3 cm. diameter, commonly 15 mm., pallid-yellow to bay-brown when dry. Peridium 100–250μ thick, of densely compacted, partly gelatinized hyphae, externally tapering off into separate threads and appearing somewhat tomentose. Gleba ochraceous to ferruginous, cells small, 3–4 mm., subglobose, filled with spores; tramal plates 35–50μ thick, of densely woven, partly gelatinized hyphae, sometimes scissile at the gussets; basidia 2-spored. Spores broadly fusiform or acuminate-elliptical, golden-brown, 12–16 × 8–10μ, covered with a gelatinous membrane which appears prominently areolate, 2·5μ thick, apex bluntly acuminate, base shortly pedicellate.

Type locality.—Hobart, Tasmania.

Distribution.—Australia; Tasmania.

New South Wales: Parramatta, 7/12, J.B.C.* (Det. by Rodway as *H. albellus*); Mosman, 7/15, J.B.C.*—Tasmania: Unknown locality, L. Rodway; Waterworks, Hobart, L. Rodway (Type collection, herb. L. Rodway).

From *H. nanus* this species is separated by the different spores and basidia; and from *H. zeylanicus* by the different peridium and smaller spores.

8. Hymenogaster zeylanicus Petch. Text-figs. 12, 24.

Ann. Roy. Bot. Gard. Peradeniya, vi, 1917, p. 207.

Plants irregularly subglobose or pyriform, to 20 mm. diameter, ochraceous or ferruginous brown. Peridium 100–125μ thick, pseudoparenchymatous, covered exteriorly with scattered hyphae arranged in a radial manner. Gleba umber brown, cells subglobose, 1–2 mm., filled with spores; tramal plates 45–70μ thick, of woven, partly gelatinized hyphae, strongly scissile; basidia 2-spored. Spores broadly fusiform or citriform, apex acuminate, base shortly pedicellate, deep chestnut-brown, 15–22 × 9–12μ, coarsely areolate.

Type locality.—Hokgala, Ceylon.

Distribution.—Ceylon; New Zealand.

New Zealand: Wellington, Palmerston North, 5/23, G.H.C. (Det. by Dodge as *H. zeylanicus*).

The large areolated spores separate this from all save the following species; from this it is separated by the different peridium and different shape and markings of the spores. The species was identified for me by Dr. Dodge; and his diagnosis has been confirmed by comparison with part of the type (kindly loaned by Dr. Shear) forwarded by Petch to Lloyd (No. 37975).

Our plant differs in several minor details from the original description, but examination of the type specimens has shown that they agree too closely to allow of separation. The basidia are typically 2-spored, not monosporous as stated, and the spores and tramal plates are of the dimensions given above.

9. Hymenogaster macrosporus, n. sp. Text-figs. 16, 25.

Plants irregularly globose, to 2 cm. diameter, ochraceous or dull cream colour. Peridium 80–200μ thick, of partly gelatinized, parallel hyphae. Gleba dark ferruginous, or chocolate-brown, cells empty, subglobose, 1–2 mm.; tramal plates 40–160μ thick, of densely woven gelatinized hyphae, hyaline, usually scissile; basidia 2–4-spored. Spores elliptical or obovate, golden-brown, 18–24 × 12–17μ, distinctly reticulated, wings of reticulations to 2μ tall, endospore 2μ thick and deeply coloured.

Distribution.—Tasmania: Cradle Mountain, 11/25, G. Weindorfer (Type collection, in herb. L. Rodway).

The species is characterized by the reticulated epispore and thick, coloured endospore.

10. Hymenogaster reticulatus, n. sp. Text-figs. 15, 26.

Plants subglobose, to 15 mm. diameter, bright ochraceous or yellowish-brown. Peridium 120–300μ thick, of densely woven hyphae which exteriorly are more loosely arranged, not gelatinized. Gleba ferruginous, cells subglobose, minute, 5–6 mm., empty; tramal plates 50–80μ thick, of woven, strongly gelatinized hyphae, scissile at the gussets; basidia apparently 2-spored. Spores fusiform, both ends acuminate, or spindle-shaped, clear fuscous brown, 18–22 × 11–15μ (including spindle and reticulations), strongly and coarsely reticulated, wings to 3μ tall, endospore thin, 1μ thick.

Distribution.—Australia; Tasmania.

South Australia: National Park, 4/24, J.B.C.*—Tasmania: Hobart, L. Rodway (Type collection, herb. L. Rodway).

The species is separated from the preceding by the spindle-shaped spores, the greater degree of reticulation, thin endospore, and smaller cells of the gleba.

Doubtful and Excluded Species.

(*a*). *Hymenogaster albidus* Mass. et Rodw. = *Gautieria albida* (M. et R.) G. H. Cunn.

(*b*). *H. barnardi* Rodw. = *Hymenogaster fusisporus* (M. et R.) G. H. Cunn.

(*c*). *H. fulvus* Rodw. = *Dendrogaster fulvus* (Rodw.) G. H. Cunn.

(*d*). *H. klotschii* Tul.—Recorded by Cooke (1892, p. 247) from Western Australia. I have not seen specimens, and it is not possible from the description to ascertain the identity of the plant so listed.

(*e*). *H. lycoperdineus* Vitt.—This has been recorded by Cooke (1892, p. 247) from Western Australia. Unfortunately the description is so scanty that it is not possible to refer the collection to any species known to occur in this region.

(*f*). *H. moselei* Berk. et Br., *Trans. Linn. Soc.*, ii, 1882, p. 40.—The species was recorded as being collected in New South Wales. The description is too scanty to permit of identification; the citrine colour suggests that the species may be the same as *H. aureus* Rodw., and this is supported by the fact that the spores are fusiform, smooth, and 11–14 × 7μ. This I have been able to ascertain through examination of a slide prepared by Miss Wakefield from the type at Kew; but as the sections were such that it was not possible to ascertain the nature of the tramal plates, gleba and peridium, the identity of the species is still uncertain.

(*g*). *H. rodwayi* Mass. = *Gautieria rodwayi* (Mass.) Z. et D.

(*h*). *H. violaceus* Mass. et Rodw. = *Dendrogaster violaceus* (M. et R.) G. H. Cunn.

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EXPLANATION OF PLATE IV.

Fig. 1.—*Rhizopogon rubescens*, × $\frac{3}{5}$. Photograph of the fresh plant showing rhizomorphs. Photo H. Drake.

Fig. 2.—*Rhizopogon rubescens*, × 3. Section through developing plant showing the cellular structure of the gleba. Original.